



where technology and public health meet

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is a revolutionary crossover invention currently under development for early identification and prevention of disease spread, monitoring of public health and detection of epidemic outbreaks, by combining advanced technology and cutting-edge sanitation.



Artist's impressions of a MEDiLOO® toilet: courtesy of FLEX/design and IHE Delft

What is MEDiLOO®?

MEDiLOO® is a revolutionary crossover invention currently under development for early identification and prevention of disease spread, monitoring of public health and detection of epidemic outbreaks, by combining advanced technology and cutting-edge sanitation.

MEDiLOO® is a valuable addition to existing public health systems which can be adapted to various states of medical development and local circumstances. It is not a replacement for traditional medical diagnostic methods; its main benefits are (i) improving sanitation management, especially under challenging conditions usually prevailing in less developed countries, (ii) continuous non-invasive monitoring of the health of its users, and (iii) early indication of diseases and outbreaks.

How does the MEDiLOO® work?

MEDiLOO® integrates three distinctive components: (i) a non-invasive screening system inside and outside the toilet, (ii) data handling and communication software (MEDiLOOapp®), and (iii) a state-of-the-art sanitary facility/toilet.

Non-invasive screening system

The non-invasive screening system includes a combination of various technologies, some readily available, and some about to be adopted or developed for a particular application. The spectre of diseases (malaria, cholera, typhus, tuberculosis, pneumonia, hepatitis, etc.) of interest dictate the required instrumentation.

The functions can be upgraded and downgraded, depending on the selection of diseases to be monitored. For the selection shown in the overview illustration, MEDiLOO® envisages the use of (i) lab-on-a-chip technology, (ii) various types of sensors, (iii) optical identification cameras, (iv) hyperspectral cameras, and (iv) urinalysis including test strips. Screening and measuring are not expected to affect the normal behaviour of the user on the toilet, nor to prolong the toilet occupancy. Depending on the configuration, the measuring and sensor technology is located inside and partially outside of the MEDiLOO® toilet. The user is exposed to screening / measuring only when in front of the toilet and during the stay in the toilet. Most of the functionalities of the toilet, which do not require intervention by the user, are invisible. Minimum interaction with and intervention by the user is one of the main design requirements of this toilet. However, when it is required, the required actions are non-invasive, fast, logical, simple and user-friendly, and do not require special training or lengthy usage instructions.

MEDiLOOapp®

The information obtained by the screening system is processed during the occupancy of the toilet and will be available immediately. It should be noted that one symptom can be linked to more diseases and vice versa, that more parameters can be indicators for a single symptom and vice versa, that a single parameter can be measured by several techniques and methods and that for each measurement or analysis a standard error is determined. In

addition, a sensitivity analysis for each parameter is included in the software to link the obtained values to medically accepted standard ranges of health indicators. For each parameter, a description of categories within a practical scale of obtained results is provided. Using standard principles of multi-criteria analysis, applying scoring and weighing, the combination of a person's conditions is instantly evaluated by the MEDiLOOapp® software, which will identify a person(s) as potentially ill with the advice to visit a doctor. Depending on the privacy package applicable for a particular local situation, the visitor (or any other authorized user of the information) can be informed about the results in either a simple or a more extensive manner. For example, light signals in different colours can be positioned inside the MEDiLOO® toilet, indicating the gravity of his/her health condition (green: no indication of health issues, yellow: recommendation to see the doctor, no urgency, and red: contact the doctor immediately). These, and more advanced information, including the results of screening, can also be obtained from the MEDiLOOapp®, given that the user or authorized person has created an account and accepted the privacy and ethics policies in place. In the case of a yellow or red light indication (when there is an indication of a transmittable disease or diseases), the toilet will automatically be locked down, and emergency security procedures will be engaged including the safe removal and handling of the contaminated waste, and cleaning and disinfection of the toilet. A service alarm will be sent to the designated

person in charge of the operation and maintenance of the MEDiLOO® toilet, while the health warning signal/message will be shared with the user or authorized person in charge (depending on the application). For visual impaired users, a trill alarm can be added to the toilet and smart phone. All the electronic components are integrated into a system with a central processing unit with microcomputer and the communication hardware, GPS and GSM cards, to link the toilet with the authorized user, via the MEDiLOOapp®.

State-of-the-art toilet

The third component is a MEDiLOO® toilet structure and infrastructure. The main function of the toilet structure is to integrate the sanitation features of a toilet with the technological features for health screening. The toilet infrastructure is necessary to make the toilet operational and sustainable. The MEDiLOO® toilet from a sanitary engineering perspective can be supplied as a standalone unit or in blocks, dry or water-based, urine diversion or mixed, squatting or seating, etc. This all depends on the cultural, social and economic conditions in the place of application. The MEDiLOO® configurator will also have a module which will deal with the selection of the most appropriate technical solution (toilet type) from the sanitary engineering perspective. For example, requirements for emergency sanitation are more demanding in comparison with standard sanitation (e.g. because of the need of rapid deployment, transport, erection of a large

number of toilets in a short period of time and many other factors). MEDiLOO® toilets are envisaged to be built locally, as much as possible from local materials, and to be self-sustainable for energy thanks to solar panels incorporated in the roof. The present design concept includes the safe (containerized) collection of human excreta (faeces and urine) and of menstrual hygiene products that enables their safe transport to a designated treatment/disposal location.

What about privacy and ethics?

The data will be handled, stored and used according to privacy policy and ethical considerations developed for a particular application/situation. The software has the capacity to collect, process and store large amounts of individual data and the information is capable of identifying the early symptoms of epidemics in the region of interest. In addition, the software is capable of longitudinal monitoring of the health of individuals and groups. In acknowledgement of the diversity and complexity of challenges in urban sanitation worldwide, the MEDiLOO® considers the requirements of women and men, adults and children, and people with disabilities.

Can MEDiLOO® be customized?

Because of the diversity of objectives, target diseases and associated ethical and privacy conditions, the MEDiLOO® configurator has been developed. This is a decision support tool for the selection of the most appropriate and cost-

effective combination of MEDiLOO® functionalities that are tailor-made for particular target group(s) and application(s). The MEDiLOO® configurator applies an eight-step approach that will lead to the required combination of features and functionalities of the MEDiLOO® for a particular situation. Depending on the scope defined in the MEDiLOO® configurator, the cost of the MEDiLOO® toilet system can be determined. The content of the configurator shown below is only indicative and it can be shortened or expanded, depending on the scope, objectives, ambition, available technology and analytical tools.





a tool to fight bacteria, viruses and other pathogens

Step 1	Step 2	Step 3	Step 4
Select target group(s)	Select public health objective(s)	Select data and privacy policy	Select ethical concept
Pupils Schools	Acute snap shot screening	Personal and protected	Personal
Students Universities	Acute early warning epidemics	Personal with permission	National
Soldiers Military bases	Chronic longitudinal monitoring	Big data anonymous	General
Refugees Refugee camps			
Patients Field hospitals			
Families Households			
Citizens Public toilets			
Tourists Hotels and camps			
Pilgrims Holy places			
Passengers Airports			
Step 5	Step 6	Step 7	Step 8
Select target disease(s)/condition(s)	Select symptom(s)	Select parameter(s) of interest	Select technology/method(s)
Malaria	Fever	Temperature	Sensors
Cholera	Diarrhoea	Stool	Optical identification cameras
Typhoid	Diarrhoea + blood	Stool Blood	Hyperspectral cameras
Paratyphoid	Dehydration	Urine	Urinalysis Test strips
Dysentery	Hemoglobinuria	Blood	Lab on chip technology
Tuberculosis	Hypoglycemia	Heart beat	
Influenza	Slow pulse	Weight Length	
Trachoma	Fast pulse	Eye lid	
Worm infection	Red eyes	Eye white	
Hepatitis	Swollen eyelids	Skin	
Malnutrition	Eyelid discharge	Breath	
Underdevelopment	Loss of weight		
Obesity	Jaundice		
Anaemia	Yellow eyes		
Pneumonia	Brown urine		
	Light stool		
	Overweight		
	Underweight		
	Cough Sneeze		

MEDiLOO® is a concept of the Foundation J and J Consortium further developed in cooperation with IHE Delft Institute for Water Education and a multidisciplinary team of experts, academic and research institutions, designers, ICT companies and technology suppliers.

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